THEOLOGY AND SCIENCE, 2016
http://dx.doi.org/10.1080/14746700.2016.1156327

Values and Science: An Argument for Why They Cannot Be Separated

Josh Reeves

ABSTRACT
A distinction between facts and values is often assumed when people in the modern West talk about science. The biologist Stephen Gould, for example, famously argued that religion covers questions of meaning and moral value, but science deals with empirical facts. This paper challenges the traditional fact/value distinction by questioning the presuppositions about science upon which it depends. It begins by describing the origins of the fact/value distinction in the Scientific Revolution and then gives three reasons for the inseparability of facts and values in scientific inquiry, drawing upon themes from the "practice turn" in recent scholarship on the sciences.

KEYWORDS
Values; Facts; Scientific Revolution; Science and religion; Fact/value distinction

Downloaded by [Samford University] at 14:40 13 June 2016

The popular image of science endorses a stark contrast between facts and values. Because humans inhabit a world with a determinate structure, scientific claims are true or false regardless of human desires or intentions.[1] Values—what one judges as being worthy of being promoted or advanced—are human projections imposed on nature, not inherent within nature itself.[2] While moral or political values may guide the application of scientific knowledge, permitting considerations of value into scientific inquiry can only corrupt the knowledge it produces.

A sharp distinction between facts and values reinforces the common separation between public knowledge and private belief in modern Western culture, and the belief that science and religion are best separated. Stephen Jay Gould famously argued, for example, that the domain of religion covers questions of meaning and moral value, but does not overlap into the domain of science, the realm of empirical fact.[3] The role of values in science is also controversial among philosophers; for example, Michael Ruse has questioned Ernan McMullin's position that only epistemic values (e.g., the desire for consistency) have a legitimate place in scientific inquiry, insisting on the influence of culture on science.[4]

Despite being widely accepted, the fact/value dichotomy is not self-evident. It was not held before the emergence of the "new philosophy" in the seventeenth century, and many scholars in recent decades have challenged the distinction.[5] This paper will examine the debate about science and values, beginning with a brief description of the origins and motivations for the common view. Because the fact/value distinction is often taken as

CONTACT Josh Reeves jareeves@samford.edu
© 2016 Center for Theology and the Natural Sciences

commonsense, describing its origins in intellectual history is a helpful first step before arguing for an alternative. I will then present a challenge to the fact/value distinction which draws primarily upon recent literature from the field of science studies. If the modern separation of facts and values is untenable, then it provides an additional rationale for theological engagement with the sciences, for the manner in which scientific inquiry develops, I will argue, depends partly on the aims of the scientists who pursue it.

Origins of the fact/value distinction

While their views of nature are varied and complex, in general medieval scholars thought values were inherent in the natural world. The Platonic tradition, embraced and modified by the Church Fathers, argued that God had infused the created world with symbols that point beyond themselves to a superior world of spiritual realities.[6] For Plato, the philosopher who becomes familiar with the divine order in the cosmos "becomes as divine and orderly as a human being can."[7] The Aristotelian tradition of natural inquiry that reached ascendancy in the universities of the high Middle Ages viewed nature as being infused with purpose or *telos*, with each thing striving for order and fulfilling the will of the Divine mind. Aristotelian scholastics offered an integrated view of the human and the natural, for an analysis of human action differed only in degree from those of natural processes.[8] Both traditions thus accepted that the natural world was infused with a structure and potentiality which, if correctly understood, could help one to live well. To focus solely on the inner-workings of material objects would miss the essential moral function of nature. What was worth living for was not a projection of the human mind onto an indifferent universe, but something discovered as one brought oneself into alignment with the natural order of things.

Advocates of the new philosophy in the seventeenth century rejected the medieval view on the relation of values to nature for two central reasons. First, many accepted a new image of nature, a view often called the *mechanical philosophy*. A central characteristic of the various mechanical philosophies of the early modern period is their reformulation of what counts as a proper explanation.[9] All phenomena were to be explained in terms of the shape, size, quantity, and motion of particles of matter.[10] Consequently, real qualities in the Aristotelian worldview became merely secondary qualities in the mechanical philosophy, or effects of the particles on the senses. Values were seen as a product of human subjectivity; like color, not existing in the world independent of human perception.

The second reason for the rise of the fact/value distinction was a new conception of objectivity and its role in scientific inquiry. For many advocates of the new philosophy, proper study of nature required the removal of considerations of value, morality, and politics from science.[11] This new conception of inquiry is seen in the emergence of a new meaning of objectivity in the seventeenth century. The term *objective* (*objectus*) also had a distinct meaning in scholastic philosophy, for it chiefly pertained to objects of thought, rather than objects in the external world or inner dispositions.[12] The term was formulated to solve the problem of how to express the relationship between the representation of something in the mind and the thing itself.[13] A statement was considered true only if the formal concept and the objective concept conformed to one another.

Downloaded by [Samford University] at 14:40 13 June 2016

Downloaded by [Samford University] at 14:40 13 June 2016

The meaning of the terms "experience" and "objectivity" changed dramatically as the framework of scholasticism gave way during the early modern period. Seventeenth-century English natural philosophers began to advocate for an experimental approach to the study of nature, emphasizing first-hand experience and experiment over reliance upon authoritative textbooks.[14] This reforming impulse in early modern natural philosophy had to reconcile two opposing impulses: the desire to build a natural philosophy based solely on particular human experience, while recognizing the woeful limits of anyone's individual experience.

The legal system offered a promising way forward for English empiricists who wanted to show how abandoning the goal of certain knowledge does not lead to skepticism, for it taught that facts could be established with high certitude by the witness testimony of ordinary persons.[15] The members of the Royal Society incorporated this view in their promotion of a philosophy that preferred facts over hypotheses, the former which are adequately witnessed and theory-neutral statements of natural events, whereas the latter was conjecture, even if well-founded. In order for the system to work properly, natural philosophers must function as jurists with sufficient impartiality to testify and make judgments about matters of fact.

The emphasis on the personal qualities of the natural philosopher, in turn, led mid-seventeenth-century English natural philosophy to a new notion of objectivity, which is characterized by "impartiality, freedom from prejudices, lack of bias, and lack of partisanship."[16] Without scholastic epistemology and its notion of an objective concept, objectivity ceases to provide the ground for truth and instead refers to the personal characteristics of the knower. Objectivity now refers to the state of the individual—meaning it becomes possible to talk about degrees of objectivity—and is no longer a term describing the relation of knowledge to its object.[17] The legitimacy of scientific inquiry, as a result, varied to the extent that the scientist could control the natural human inclination to project one's own beliefs onto the natural world.

The two streams of early modern natural inquiry described above converge in the work of David Hume, the Scottish philosopher of the eighteenth century whose arguments still inform current debates on facts and values. Hume celebrated the mechanical view of nature, hoping even to extend Newton's theory to cover the human mind.[18] He also famously argued that values have no place in legitimate research because "ought" cannot be derived from "is," meaning that values cannot be deduced from facts, an argument that later philosophers refer to as "Hume's law" or "Hume's guillotine."[19] Philosophers should distinguish between descriptive statements that can reflect the world and normative statements that reflect human desires. If our descriptions of nature include no moral premises, then we can draw no moral conclusions. Hume's work forcefully articulates the consequences of the Scientific Revolution for many in the West: science teaches us that nature is an uncaring machine, a vast reservoir of technological power that is unable to support moral inferences.[20]

Science as practice

Before critiquing the strict separation of facts and values by Hume and other modern thinkers, this section will describe the "practice turn" which occurred in the disciplines of philosophy, history, and sociology of science, respectively. The Cambridge historian of science

James Secord summarizes the significance of practice theory this way: "The move to study practice has, in my view, been the single most significant transformation in the field during the past twenty years."[21] The turn reorients many traditional debates about the nature of science and has implications, I will argue, for the debate over fact and values.

Philosophical discussions of science in the twentieth century were strongly shaped by logical positivism and its attempt to purify science of metaphysics and reconstruct science in empiricist terms. Characteristic of their program was the elevation of mathematic physics as the exemplar of science, the conceiving of theories as propositions about the world, and the belief that science was unified by a common methodology. Even critics of logical positivism shared their concern with matters of epistemology, and often portrayed science as a body of knowledge which progresses through the operation of rationality, objectivity, or method.[22]

Though logical positivism has long been dead as a research program, there has been increasing criticism by philosophers about the way it shaped the debates of twentieth-century philosophy of science. As a result of the singular focus on metaphysics and epistemology, scientists were often portrayed as featureless and abstract reasoners.[23] As a way to move beyond these assumptions, many recent philosophers refer to science as a practice, defined as "embodied, materially mediated arrays of human activity centrally organized around shared practical understanding."[24] Describing science as a practice is a way to highlight it as a practical activity, drawing one's attention to scientists in action and the embodied nature of scientific knowing. The nature of scientific skill is entwined with the character of the human body, in both its ability to shape and be shaped by its environment. Whereas ideas can be abstracted and decontextualized in order to be evaluated and transmitted elsewhere, practices only exist to the extent that scientists continually reproduce them.[25] In sum, the distinctive emphasis of practice theory is to understand science in action (i.e., focus on the everyday activities of scientific practitioners) and science as action (i.e., science as an embodied skill). Reified notions of science as theories inhabiting a Platonic realm have given way to accounts which stress the embodied nature of scientific reasoning.[26]

For practice theorists, traditional philosophers of science have too often portrayed scientists as philosophers, whose theories are a collection of propositions about the world. If that was the case, one could become a scientist through the memorization of scientific theories. Yet as Thomas Kuhn noted, scientific students commonly believe they have a proper conceptual grasp on a particular theory, but then are unable to solve problems at the end of chapters in a scientific textbook. One cannot become a scientist through the memorization of theories, but rather by working through exemplars to acquire relevant skills, which can then be generalized to apply to a wider range of problems. For example, the way to become a physicist is not to reflect on the inner meaning of F=MA, but to learn to identify forces, masses, and accelerations in specific physical situations, which is then extended to solve new and more complex problems.[27] A scientist's knowledge resides in the ability to "perform" the solution to a problem when required to do so and not in the mental retention of definitions and rules.[28]

The goal of science, from a practice perspective, is not merely to produce beliefs that correspond to reality but to transform human ability to cope with the world. The philosopher Joseph Rouse explains the difference with an analogy:

Downloaded by [Samford University] at 14:40 13 June 2016

> Biologists understand cells in the sense in which we say that a good mechanic understands cars. Biologists and mechanics can, if asked, produce many true sentences about what they work on, but that is hardly the point in either case.[29]

To do science properly requires skill, meaning one cannot fully know a theory unless they are able to properly use it. Scientific research reconstructs the world as well as redescribes it, and so is a kind of practical activity that bears strong affinities to other types of craft knowledge.[30] As Andrew Pickering says, "What scientists do is just as important as the knowledge they produce."[31]

Practice theorists do not deny, as some Marxist historians of science have done, the importance of theory in science, but rather insist that scientific theorizing is inextricably tied to scientific action. The strict separation of pure and applied science is not helpful: there is too much practice in the theory of science, and too much theory in the practice of science. It is the union of theoretical and material forms of reasoning which explains much of scientific success. A number of historians and sociologists have thus begun employing the term *technoscience* in order to avoid making sharp distinctions between pure and applied science.[32]

Emphasizing the role of skill in science has also brought new issues to philosophical prominence, including scientific pedagogy. Theory-centered philosophies of science have tended to neglect the training needed to inculcate the skills that are intimately connected to and undergird the completed theories of scientific textbooks. As Warwick and Kaiser explain,

> [Previous] traditions have had almost nothing to say about scientific training as they tend to depict scientific theories as static and self-contained collections of propositions, and to analyze them according to criteria that are independent of the practical skills taught in formal science courses.[33]

In the Enlightenment image of science, social influences are containments against which the individual scientist must guard. But a pedagogically oriented philosophy of science recognizes "those conditions that make it possible to know, to develop, and to apply such collections of ideas."[34] Emphasizing the power of training leads to a more nuanced understanding of the influence of local context on producing scientists. Scientific training shapes not only behavioral habits but also self-image, perspectives, attitudes, values, desires, and objectives, all of which bear the marks of time and place.[35]

In sum, practice theory challenges the intellectualist image of science bequeathed by positivism by rejecting the separation of the theoretical and practical dimensions of science. The question for the rest of the paper is: how does this understanding of science reconfigure the fact/value debate?

Epistemic versus non-epistemic values

Before presenting three reasons for the inseparability of facts and values, a quick discussion of the distinction between epistemic and nonepistemic values would be helpful to clarify my position against others who have written on the topic. Under the influence of positivism in the first half of the twentieth century, many philosophers and scientists argued for science as a value-free enterprise. Positivists acknowledged that values may guide the choice of scientific problems or proposed solutions, what was called the

Downloaded by [Samford University] at 14:40 13 June 2016

"context of discovery," but said values cannot play a role in assessing the truth of a theory, called the "context of justification."

After the decline of positivism, philosophers began to accept values as having a legitimate role to play in science. Kuhn famously argued that scientists often are confronted with rival theories which attempt to explain the same data, and so they make choices according to epistemic values. That is, they choose theories with the best combination of accuracy, consistency, scope, simplicity, and fruitfulness. These values—and philosophers have added others to the list—play an important role in improving the epistemic status of scientific theories. As McMullin explains, "An epistemic value is one we have reason to believe will, if pursued, help toward the attainment of … knowledge."[36]

The current debate on values and science is not about whether epistemic values play a valid role in science. Philosophers agree that they do, even though the positivistic image of science still lives on in the cultural imagination. Scholars also do not debate the importance of nonepistemic values in choosing problems and applying scientific technology within the broader culture, what positivists would place under the heading of "context of discovery." Current debates center on whether and to what degree nonepistemic values—those values relating to morality, politics, or culture—should play a role in theory choice.

Values in the practice of science

Are values a part of scientific inquiry? From a practice theory perspective, the answer is yes for three different reasons: the fact/value distinction is mistaken because scientific inquiry is not independent of action, scientific theories are not passive representations of the world, and knowledge is inextricably perspectival.

First, practice theory undermines the fact/value distinction by challenging the assumption that scientific knowledge is independent of action. As argued above, scientific inquiry is connected to the way a practitioner engages the natural world. Science is not merely about developing an accurate world-picture but also about techniques which give scientists power over matter. The scientist cannot escape the consequences of his or her action merely by appealing to a value-free ideal of science because each step along the path of scientific inquiry involves actions that can be morally evaluated. Whether for applications that are seen as morally suspect (e.g., weapon research), morally praiseworthy (e.g., medical research), or, more likely, as neither (e.g., research into the chemical composition of stars), the acquiring of new knowledge requires the researcher to shape and be shaped by the world around them. Even when a research topic has no obvious moral implications, scientific inquiry can be evaluated based on the research paths not taken. Since the search space is so vast, what questions will we attempt to answer using our finite resources? The paths we choose to explore, and especially what money we choose to invest, expresses what we value.

The importance of values in scientific inquiry is heightened when we recognize that the structure of scientific inquiry has changed over the past century. We now live in the era of "big science."[37] The majority of science since World War II has been funded by large companies or national governments, a shift encouraged by the Cold War. President Dwight Eisenhower noted this in his farewell address to the nation:

Downloaded by [Samford University] at 14:40 13 June 2016

> Today, the solitary inventor, tinkering in his shop, has been overshadowed by task forces of scientists in laboratories and testing fields […] The prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever present —and is gravely to be regarded.[38]

He was wary of the transformation in science because governments and corporations are mainly interested in projects that maximize profits or destruction, shaping scientific development in ways that do not benefit society. Because of the diffusion of responsibility which occurs in large organizations, researchers can work on projects without feeling morally responsible for funding decisions. In light of the tremendous power and moral responsibility of those who fund science, the fact/value distinction is pernicious because it allows the choices of big companies and politicians to remain hidden behind a cloak of neutrality.[39]

The first objection to the fact/value distinction is the least controversial; even positivists might accept my characterization as part of the context of discovery. It does conflict, however, with the popular political argument that scientists should be isolated from the larger society because their objectivity is compromised by public interference. Of course, the public should not interfere in the assessment of scientific theories. Yet scientific activity should always be accountable to the public, not only for the consequences of their research, but also for the research problems being investigated. Given the vast resources invested in scientific inquiry, scientists must be responsive to the values of the societies upon which they depend.

A second way practice theory challenges the fact/value distinction is by objecting to the epistemological assumptions underlying traditional accounts of scientific theories. As Richard Rorty famously argued, in classic epistemology a person can be said to have knowledge when his or her mind accurately represents the external world.[40] These representational theories of knowledge imply the existence of an inner space where the knowing subject observes the world from a metaphysical distance, what Daniel Dennett called the "Cartesian Theater."[41] But once the mind is understood as standing apart from the world, it becomes difficult to reconcile it again with the world. Practice theorists object to traditional epistemology by describing human knowledge as oriented toward what we find significant, rather than passive representations of nature. This active stance means that facts and values both play a valid role in human knowing.

The interrelation of science and values in human knowledge can be seen by comparing science to map-making, for maps show how it is possible for something to be both objective and reflective of human interests.[42] Cartography is not governed by a context-independent goal, such as the desire to describe the world as it is in itself. Maps filter out most features of the terrain in order represent objects of cartographical significance to the person and communities that produced it. In other words, there is no such thing as an ideal map, otherwise they would be as large and unwieldy as reality itself. Philip Kitcher gives the following example:

> One map of a California resort region may display major roads, sports facilities, restaurants and services surrounded by a sparsely marked expanse of green, grey, and blue; another, designed for the serious backpacker, may show the roads only as conduits to the wilderness, while lavishing detail on the courses of streams, the sinuosity of the tree-line, the contour lines, and the trails.[43]

Downloaded by [Samford University] at 14:40 13 June 2016

One can imagine any number of maps to reflect whatever features the mapmaker wishes to represent.

The same lessons hold true for scientific inquiry. Just as map-makers must simplify their accounts of reality, so too physicists and other scientists must simplify their models in order to make them workable, a fact that was neglected by the positivist tradition of philosophy of science. The nature of scientific models also refigures what it means to say a theory is true, as in cartography. Theories are not true because they are like photographs, a perfect likeness of nature, for there is always a need to simplify theories to make them manageable and useful. As the philosopher of science Paul Teller argues, "To have theories which we can actually apply in describing and understanding the world we have no choice but to work with nature to do what it does not sufficiently do by itself: We must simplify further."[44] Theories work when they allow persons to use the map to guide actions toward intended goals. Accordingly, what scientists seek about the world is not just truth—there are too many truths in the world to catalog them all —but significant truths, truths that are important from a human perspective.[45] Scientific theories thus reflect both the reality that scientists are trying to map and the interests of those persons who are constructing the map. Kitcher says again, "Like maps, scientific theories and hypotheses must be true or accurate (or, at least, approximately true or roughly accurate) to be good. But there is more to goodness in both instances."[46] Even if one believes that it is possible, in principle, to have a complete description of an objective reality, scientific theories cannot give a perspective-free account of reality because of the way humans represent the world.

A final parallel between map-making and scientific inquiry: just as maps are redrawn as human knowledge and interests change, so too do scientific theories change as scientists reassess what is most important in their research, especially as more territory is discovered. Scientists in active research programs do not have the benefit of hindsight; they must interpret the significance and validity of their research as it unfolds. Each new interpretation can transform the significance of previous work. As Kuhn noted, when new paradigms emerge, previous research projects are often abandoned; their achievements are no longer seen as significant in light of the new perspective. The flux of scientific knowledge is seen in the constant replacement of scientific textbooks. As scientific practices develop, they constantly reinterpret past achievements and excise previous results because they are no longer seen as relevant, making new textbooks necessary.[47]

This second point objects to the positivist characterization of science as the slow accumulation of theory-neutral facts but is still compatible with moderate forms of scientific realism, which claim that science is mapping a mind-independent world. It suggests, however, that the epistemic/nonepistemic distinction does not accurately describe scientific reasoning. The reason can be seen when science is popularized for lay audiences: as scientists draw broader conclusions about the state of their field and "science" on the whole, they must choose which subset of evidence to represent on their maps. When scientists tell these larger narratives, even when accurately presenting the scientific facts, one can always question whether their values have unduly influenced their presentation. Given the vast amount of scientific research, why include these facts and why leave others out? Many of the debates of the last century in science—the role played by our genes, the directedness of evolution, the existence of ontological randomness—are helpfully analyzed against the larger cultural values presumed by the particular scientist.

Downloaded by [Samford University] at 14:40 13 June 2016

This is not to say science is merely a projection of our values; empirical science can make progress in dismissing hypotheses because they are unsupported. It is to say, however, that there will always be multiple ways to read the significance of the empirical data, and values cannot be eliminated from those interpretations.

The final way practice theory challenges the fact/value distinction aligns with the more common objection that was described in the introduction and is the most controversial. According to this view, facts are not neutral descriptions of the way things are independent of human knowledge because human factual knowledge is inescapably shaped by our values, presuppositions, and interests, which are shaped by particular social and historical locations. The fact/value dichotomy operates under the assumption that there can be knowledge independent of human perspective, a view from nowhere. But one's perspective is so entangled with "reality" it becomes impossible to endorse the idea of us mapping something which is "mind-independent."[48] Without any way to talk about the world without at the same time conceptualizing it from particular viewpoint, we should therefore relinquish any hope of separating facts and values.

Practice theorists accept the perspectival critique of naive scientific realism, which denies that the representations of the scientific community mirror the structure of the world. As I discussed above, the "practice turn" in science studies not only emphasizes the tacit dimension to knowledge, but also pedagogy, what is required to become enculturated into a community of practitioners. To become a member of a practice, not only accepts the adequacy of the standards that define the practice, but one must be initiated into a new way of seeing, understanding, and manipulating the world.[49] As Kuhn has argued in *The Structure of Scientific Revolutions*, the world we perceive is a joint product of the things in themselves and the structuring activity of scientific descriptions.[50] The interpretation of experimental data always requires the presence of scientific theory and hypotheses. These background assumptions reflect both the education in which a scientist is trained and the society in which a scientist operates. Practice theorists thus provide a more compelling account of the role of perspective in knowledge, for they describe how one's perception of the world is instilled by our social groups, making a scientific "view from nowhere" impossible. From the perspective of most practice theorists, science is both value-laden and a source of reliable knowledge.

Those who would accept the perspectival critique of scientific realism would reject the epistemic/non-epistemic distinction because it is too rigid, not recognizing the importance of culture upon scientific inquiry. Scientists should not be seen as computers following the algorithm of the scientific method, but as detectives who attempt to make good decisions about which leads are most promising. Decisions about which theories are best supported depend on expert judgment, which cannot be walled off from one's ethical and metaphysical assumptions that are embedded in a larger culture. In other words, scientists bring all of their cognitive resources to bear on scientific problems. To put the point in terms of Imre Lakatos, values function as auxiliary hypotheses, indirectly influencing the hypotheses that are formed about our direct experience.[51]

Does the inextricable role of non-epistemic values threaten the objectivity of science? I do not believe so, just as long as our non-epistemic values do not weaken or replace our epistemic values, such as the desire for truth. If values were allowed to be asserted independently of epistemic values, then science merely would be the occasion for individuals to project their own wants and desires upon the world. But when non-epistemic values

Downloaded by [Samford University] at 14:40 13 June 2016

work in concert with epistemic values, the process of science is improved. It is better for scientists to acknowledge their values explicitly, opening them up for critical scrutiny as much as possible and creating a system of checks and balances among different scientists. The existence of scientists with different values leads to a further range of hypotheses, allowing for a wider scope of theories. For example, we do better science now because we have feminist philosophers of science who have helped make us aware of the role of value judgments that were hidden from view.

By contrast, pretending value judgments do not exist harms science. For example, because the is/ought distinction still is often presumed in the wider culture, climate change debates get sidetracked because scientists are accused of advocating their values, making their research suspect.[52] From my perspective, the work of climate change scientists is not imperiled when they advocate for the policy of limiting carbon dioxide emissions. The real question is whether their analysis has been abnormally skewed by their values, which is done by comparing their results with other scientists. In summary, non-epistemic values will only distort when they take the place of epistemic values, rather than working in service of them.

Conclusion

The public has commonly seen science as a value-free enterprise. This is partly attributable to the Western way of understanding nature as constructed out of inert particles, making it difficult to see how consciousness and values can exist outside of the human mind. There are also political benefits which derive from the fact/value distinction: from the beginning of the Scientific Revolution, there were arguments that science differs from politics and religion by not being tinged by historical and cultural factors.[53] Not only did this help to provide legitimacy for science, it provided a potent argument for the autonomy of the sciences in the emerging research universities of the late nineteenth and twentieth centuries.

Nevertheless, my paper argues that the fact/value distinction is mistaken because it depends on faulty assumptions about science, specifically the intellectualist image of science that was presumed by its advocates. Science is a practice, meaning the theoretical and practical dimensions of scientific inquiry are inextricably connected. By severing the link between theory and action—focusing only on theories abstracted from their context—we will be more likely to exclude the role of values in our understanding of the world. Belief in value-free science is not only mistaken, it can be dangerous because science in the last century has become too large and powerful to leave it alone. The trajectory of the evolution of science is based on the interests and desires of those who fund and undertake it, and so engagement from all aspects of society are required.[54] Public participation would ensure feedback from a broad spectrum of society, so that institutions might be held accountable for the choices they make.

Understanding science as an activity refigures the debates on fact and values, and raises all sorts of value questions: who is making decisions about where a scientist should explore? What are their interests, and do they represent the larger society? Who will benefit and who will pay? The question of how to negotiate these questions is complex, of course, and there is an entire literature devoted to questions surrounding public engagement of science.[55] The first step, and the primary goal of this paper, is to others recognize the enmeshment of facts and values in scientific research.

Downloaded by [Samford University] at 14:40 13 June 2016

If my paper is correct, then it has implications for the engagement of science with religious traditions. Scholars have long debated whether a person's religious beliefs can play a legitimate role in scientific inquiry or if scientists should attempt to minimize them. My analysis of facts and values supports the idea that one's religious perspective can play a positive role in one's scientific career. In general, members of individual religious traditions should be free to use their values to guide their own work. Jewish scientists, for example, my use their career for the repair of the world and Buddhists might do the same to reveal its impermanence. As long as religious values do not overturn or weaken the epistemic values implicit in scientific practices, this should not be objectionable. My analysis thus supports Robert Russell's claim that Christian beliefs can legitimately provide background assumptions and selection rules when choosing between existing theories. In the end, facts and values are inseparable in scientific inquiry because of the nature of those who undertake the research.[56]

Downloaded by [Samford University] at 14:40 13 June 2016

Endnotes

1. Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago: University of Chicago Press, 1994), 4.
2. Harold Kincaid, John Dupré and Alison Wylie, "Introduction," in *Value-Free Science?: Ideals and Illusions*, ed. Kincaid, Dupré and Wylie (Oxford: Oxford University Press, 2007), 2.
3. Stephen Jay Gould, *Rocks of Ages: Science and Religion in the Fullness of Life* (New York: Vintage, 2002).
4. Michael Ruse, "Science and Values: My Debt to Ernan McMullin," *Zygon* 47, no. 4 (December 1, 2012): 683. Ernan McMullin, "Values in Science," *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association* no. 4 (1982), 3–28; Ernan McMullin, "Values in Science," *Zygon* 47:4 (December 1, 2012), 686–709.
5. Hilary Putnam, "Beyond the Fact–Value Dichotomy," *Crítica* 14:41 (1982), 3–12.
6. Peter Harrison, *The Bible, Protestantism, and the Rise of Natural Science* (Cambridge: Cambridge University Press, 1998), 15.
7. Plato, *Republic* (Indianapolis: Hackett, 2004), 194.
8. Steven Shapin, *The Scientific Revolution* (Chicago: University of Chicago Press, 1996), 163.
9. Josh Reeves, "On The Relation Between Science and the Scientific Worldview," *The Heythrop Journal* 54:4 (July 1, 2013), 554–562.
10. John Henry, *The Scientific Revolution and the Origins of Modern Science*, 2nd ed. (New York: Palgrave, 2001), 69.
11. Shapin, *The Scientific Revolution*, 162.
12. Lorraine Daston, "Objectivity and the Escape from Perspective," *Social Studies of Science* 22:4 (1992), 597–618.
13. Peter Dear, "From Truth to Disinterestedness in the Seventeenth Century," *Social Studies of Science* 22:4 (1992), 619–631.
14. Peter Dear, *Revolutionizing the Sciences: European Knowledge and Its Ambitions, 1500–1700* (Princeton, N.J.: Princeton University Press, 2001), 64.
15. Barbara Shapiro, "The Concept 'Fact': Legal Origins and Cultural Diffusion," *Albion* 26:2 (1994), 227–252.
16. Stephen Gaukroger, *The Emergence of a Scientific Culture: Science and the Shaping of Modernity, 1210–1685* (Oxford: Clarendon, 2006), 231.
17. Peter Dear, "From Truth to Disinterestedness in the Seventeenth Century," *Social Studies of Science* 22 (1992), 619–631.
18. David Hume, *A Treatise of Human Nature: Being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects*, ed. David Fate Norton (Oxford: Oxford University Press, 2000).

19. G.R. Grice and R. Edgley, "Symposium: Hume's Law," *Proceedings of the Aristotelian Society, Supplementary Volumes* 44 (January 1, 1970), 89–119. Lynda Walsh, *Scientists as Prophets: A Rhetorical Genealogy* (New York: Oxford University Press, 2013), 85.
20. Putnam, "Beyond the Fact-Value Dichotomy," 3.
21. J.A. Secord, "Knowledge in Transit," *Isis* 95, no. 4 (2004): 658.
22. S.J. Harris, "Introduction: Thinking Locally, Acting Globally," *Configurations* 6 (1998): 133.
23. Joseph Rouse, *Engaging Science: How to Understand Its Practices Philosophically* (Ithaca: Cornell University Press, 1996), 66.
24. Theodore R. Schatzki, "Introduction: Practice Theory," in *The Practice Turn in Contemporary Theory*, ed. Theodore R. Schatzki, K. Knorr-Cetina and Eike von Savigny (London: Routledge, 2001), 10–23.
25. Joseph Rouse, *Engaging Science: How to Understand Its Practices Philosophically* (Ithaca: Cornell University Press, 1996), 26.
26. Barry Barnes, "Elusive Memories of Technoscience," *Perspectives on Science* 13 (2005), 142–165.
27. Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 3rd ed. (Chicago: University of Chicago Press, 1996), 189.
28. Andrew Warwick and David Kaiser, "Kuhn, Foucault, and the Power of Pedagogy," in *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives*, ed. David Kaiser (Cambridge, MA: MIT Press, 2005), 393–410.
29. Joseph Rouse, "Kuhn's Philosophy of Scientific Practice," in *Thomas Kuhn*, ed. Thomas Nickles (Cambridge: Cambridge University Press, 2003), 101–121.
30. Joseph Rouse, *Engaging Science: How to Understand Its Practices Philosophically* (Ithaca: Cornell University Press, 1996), 127.
31. Andrew Pickering, *The Mangle of Practice: Time, Agency, and Science* (Chicago: University of Chicago Press, 1995), 7.
32. Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard University Press, 1987); Steven Shapin, *The Scientific Life: A Moral History of a Late Modern Vocation* (Chicago: University of Chicago Press, 2008), 3.
33. Andrew Warwick and David Kaiser, "Kuhn, Foucault, and the Power of Pedagogy," in *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives*, ed. David Kaiser (Cambridge, MA: MIT Press, 2005), 393–410.
34. Ibid.
35. C.G. Prado, *Searle and Foucault on Truth* (Cambridge: Cambridge University Press, 2006), 79.
36. McMullin, "Values in Science," 1982, 18.
37. Shapin, *The Scientific Life*, 80.
38. Dwight Eisenhower, "Farewell Radio and Television Address to the American People," January 17, 1961.
39. Harold Kincaid, John Dupré and Alison Wylie, eds., *Value-Free Science?: Ideals and Illusions* (Oxford: Oxford University Press, 2007), 2.
40. Richard Rorty, *Philosophy and the Mirror of Nature* (Princeton, NJ: Princeton University Press, 1981).
41. Daniel C. Dennett, *Consciousness Explained* (Boston: Back Bay Books, 1992), 17.
42. Philip Kitcher, *Science, Truth, and Democracy*, Oxford Studies in Philosophy of Science (Oxford: Oxford University Press, 2001), 55.
43. Ibid., 56.
44. Paul Teller, "Twilight of the Perfect Model Model," *Erkenntnis* 55 (2001), 393–415.
45. Rouse, *Engaging Science*, 166.
46. Kitcher, *Science, Truth, and Democracy*, 61.
47. Rouse, *Engaging Science*, 174.
48. Richard Rorty, "Putnam and the Relativist Menace," *The Journal of Philosophy* 90:9 (September 1993), 443–461.
49. Lorraine Daston, "The Moral Economy of Science," *Osiris* 10 (1995), 2–24.

Downloaded by [Samford University] at 14:40 13 June 2016

50. Peter Lipton, "The Truth About Science," *Philosophical Transactions of the Royal Society B* 360 (2005), 1259–1269.
51. Imre Lakatos, "Falsification and the Methodology of Scientific Research Programmes," *Criticism and the Growth of Knowledge* 4 (1970), 91–195.
52. Walsh, *Scientists as Prophets*, 183.
53. Stephen Gaukroger, *The Emergence of a Scientific Culture: Science and the Shaping of Modernity, 1210–1685* (Oxford: Clarendon, 2006), 1.
54. Sheila Jasanoff, "Breaking the Waves in Science Studies: Comment on H.M. Collins and Robert Evans, 'The Third Wave of Science Studies'," *Social Studies of Science* 33 (2003), 389–400.
55. D. Durant, "Public Participation in the Making of Science Policy," *Perspectives on Science* 18:2 (2010), 189–225.
56. Robert J. Russell, *Cosmology: From Alpha to Omega : The Creative Mutual Interaction of Theology and Science*, Theology and the Sciences (Minneapolis: Fortress, 2008), 303.

Notes on contributor

Josh Reeves is project administrator in the Samford University Center for Science and Religion.

Downloaded by [Samford University] at 14:40 13 June 2016